Air Force Research Laboratory

Visual Training Research

The role of ground-based simulation training is rapidly expanding to include highly complex and realistic combat scenarios. Visual simulation technologies are critical in creating these scenarios. Advances in visual simulation technology continue to be made in image generation, display, and database systems. However, many of these advances have not been tested in an operational environment and it is not yet clear whether they will fully support current and future simulation training requirements. The goals of the visual training research program are to define the functional requirements for visual systems, to specify design goals of visual systems under development, and to quantify the relationship between visual system capability and training value.

Research has recently been completed in the following areas:

1. Laboratory comparisons of the perceived size and velocity of objects presented on both collimated and noncollimated displays
2. The effects of stimulus motion (direction and velocity) and variations in luminance on the perceived tilt of stereoscopically viewed patterns
3. Parallel scanning requirements for veridical perception of moving imagery in laser-based projectors
4. Transition and evaluation of eye-tracking technology as an aid to simulator instruction of F-16 trainees
5. Modeling of brightness and color perception data obtained under relatively low light-level conditions

This research resulted in specific recommendations for display design, image generation requirements, and database capabilities.

Research is ongoing in the following areas:

1. The perceptual effects associated with the use of noncollimated displays for simulated out-the-window flying tasks
2. Stereovision, binocular disparity effects, and perception of depth in space as pertains to the design and use of binocular head-mounted displays
3. Spatiotemporal design requirements for parallel-scan, laser-based displays
4. Identification of optimal head- and eye-movement scan strategies used during simulated flight
5. Transition and improvement of eye-tracking instrumentation and analysis tools to support training research and as an aid for pilot training
6. Test, evaluation, and characterization of commercial-off-the-shelf image generators, databases, projectors, and screen materials

A laboratory research program has been initiated that will lead to the development of performance and design specifications for use in simulator visual displays ranging in application from individual training to large-force joint exercises. To support this research program, AFRL/HEA has a dedicated visual display and imagery laboratory, which includes collimated- and real-image display systems, stereoscopic displays, various graphics workstations, and several state-of-the-art image generation systems. AFRL/HEA has also developed an eye-tracking laboratory, which includes several eye-tracking devices, software to conduct on- and off-line analyses of eye movements, and a portable head-mounted eye position monitoring and recording system.

Combined collimated/noncollimated displays apparatus

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